Chapter 11. Synthesis

This chapter summarizes the findings of the watershed analysis and outlines key recommendations. The detailed analysis and recommendations for each of the topics can be found in the individual chapters. This synthesis provides an overview of how natural features interact with management activities to influence fish and wildlife productivity within the Elliott State Forest. The Forest is set in a landscape with dynamic watershed processes and biological productivity. This setting includes natural disturbances such as floods and landslides; the delivery and transport of water, wood, sediment and other components through streams; and the movement of fish and wildlife populations through changing habitat conditions. These natural watershed conditions interact with the Forest's ongoing management practices – roads, timber harvest and other activities – to shape and constrain fish and wildlife habitat and populations.

NATURAL CHARACTERISTICS THAT INFLUENCE FISH AND WILDLIFE PRODUCTIVITY

A number of natural characteristics promote high fish and wildlife productivity on the Elliott State Forest. The Forest's streams empty into nearby lakes and estuaries, which provide high quality habitat for fish that move into these areas after spawning and rearing in the Forest. Landslides on the Forest's steep slopes ensure periodic pulses of gravel and large wood into fish-bearing streams. The relatively well-drained slopes next to fish-bearing streams can support conifer trees that also provide a long-lived source of large wood to streams. This wood creates pools and traps gravel, which benefits both fish and amphibians.

The proximity of the Forest to the ocean and shade from dense streamside vegetation helps keep streams cool. Rapid revegetation following disturbances also helps maintain shade along streams. Douglas-fir stands naturally dominate upslope areas and, when mature, provide potential habitat for the threatened marbled murrelet and northern spotted owl. The mosaic of conifers, hardwoods, brush, and open water along streams helps support a diversity of other bird species.

Some natural features of the Forest diminish fish and wildlife productivity. The sandstone geology underlying the area yields relatively little water during the summer, forcing fish and amphibians to congregate into a condensed stream network where there is more competition for food. Also, the

shallow water increases the risk of predation. Much of the landscape has sharply confined valleys. This natural confinement does not allow streams to meander much, thereby limiting the creation of areas with slower water such as side channels (see Chapter 2, *Watershed Analysis Area Overview* and Chapter 8, *Aquatic Organisms and Their Environment*). During winter storms, water moves swiftly through these straight and constrained waterways, thereby causing, in some cases, downstream displacement of fish and amphibians.

The cobbles and gravels within stream channels consist of sandstone which quickly breaks down into sand, silt, and clay. Where stream channels lack large wood and boulders, they can scour to bedrock. Water flowing through a bedrock channel is particularly swift during floods and provides little refuge for fish (see Chapter 8, *Aquatic Organisms and Their Environment*). Fish habitat is further constrained in this terrain by the presence of a number of rock ledges in the channel that keep juvenile fish from moving upstream into some headwater streams during portions of the year. Nonetheless, the exclusion of fish from some headwater streams benefits amphibians in these portions of the watershed since fish will feed upon juvenile amphibians.

Despite these natural constraints, the Forest contains some stream reaches with high quality habitats particularly in the Tenmile region and selected streams in the Coos region, such as Palouse Creek. Many of these streams are productive spawning and rearing areas for anadromous coho salmon and steelhead trout. There are, however, many streams that currently lack complex pools and other high quality habitat, which limits aquatic productivity (for individual stream habitat characteristics, see Chapter 8, *Aquatic Organisms and Their Environment*).

MANAGEMENT FACTORS THAT INFLUENCE FISH AND WILDLIFE PRODUCTIVITY

Overall, the Forest is being managed effectively to address key issues affecting fish, wildlife, and water quality. The Forest has a well-designed and maintained road system, and most human-caused barriers to fish passage have been removed. The Department of Forestry, with assistance from the Oregon Department of Fish and Wildlife and nearby watershed councils, has an ongoing program to improve aquatic habitat, such as adding logs to streams. Where timber harvest occurs, trees are being generously retained along perennial streams and other sensitive areas. Sizable areas of the Forest are managed for the growing of old trees to benefit wildlife and fish. Some of these areas are completely off limits to future timber harvest. Some past practices have negatively affected fish, wildlife, and water quality. Information from this analysis provides a framework for understanding the positive and negative aspects of current management on the Forest. This information also helps identify opportunities to protect and improve stream, riparian, and upslope habitats.

Roads

Most road building occurred decades ago, a time when road-building standards were lower and the relationships between road location and fish habitat were poorly understood (see Chapter 3, *Historical Overview*). Historically, the first roads built in the Coast Range were

located along streams because of the relatively easy access up valleys. The Forest is unique in that most of the roads are on slopes or ridge tops, with very few along streams. There are approximately 551 miles of roads in the Forest, of which only about 49 miles (9%) are within 100 feet of a stream channel, where they have the potential to affect stream habitat by restricting riparian tree growth, confining channel movement, and delivering sediment directly to the channel (see Chapter 8, *Aquatic Organisms and Their Environment*). The majority of these streamside roads are in the Coos region.

The historical practice of side-cast road construction on steep slopes with relatively few cross-drain culverts left a number of road sections vulnerable to washouts during high-intensity rainstorms (see Chapter 6, *Erosion and Sediment*). Many of these weak sections have since failed (and were then rebuilt) or were later modified to avoid a washout. Currently, along with the Forest's progressive maintenance program during the past several decades, the road network is relatively stable. The low occurrence of road-related landslides in parts of the Forest surveyed after the November 1996 flood, in addition to a Forest-wide inventory in 1997-1998, attests to the stability of the current road system. In addition, few new roads will be needed for future timber harvest on the Forest. However, some road segments were identified as having unusually large numbers of landslides in the past. The Forest should consider reexamining these areas to avoid future landslide problems.

Recommendation:

To further minimize road-related landslides, the Forest should examine roads identified as having a large number of landslides in the 1997-1998 Forest-wide inventory. This information will help determine if impending landslides continue to develop. Roads with unusually high numbers of landslides include the 2800, 5240 and 5500 Roads in analysis basin #4 (Umpqua region) and the 5730, 5420, 4500 and 2580 Roads in analysis basin #5 (Tenmile region).

Other aspects of the Forest road system are more problematic. Based on field observations and limited road inventory data, it appears that cross-drain culverts (designed to transfer water from the road ditch to the outside edge of the road) are relatively sparse. Some of these feed directly into stream channels with intermittent or perennial flow, along with their load of fine sediments derived from the road surface and road ditch (see Chapter 6, *Erosion and Sediment*). This connection between road ditches and streams is common for roads among all land ownerships in the Pacific Northwest. It can lead to chronic water turbidity during the wet season in downstream fish-bearing waters, thereby reducing the ability of fish to feed. The sediment can be detrimental to aquatic insects, and the sand- and silt-sized component can fill in the gaps between gravels where fish eggs incubate, thereby reducing the amount of oxygen around the developing eggs. Forest staff is addressing this problem on some sections of road by installing additional cross-drain culverts so that ditch water and its sediment are filtered through the soil on stable slopes. However, the backlog of road segments to modify is large. Furthermore, this

Recommendation:

To reduce the amount of fine sediments entrained in road ditch water from entering streams, the Forest should increase the frequency of cross-drain culverts. Where roads are located parallel to streams, consider alternative techniques such as using higher-quality surface rock, paving, clearing road ditches, or decommissioning redundant roads.

solution does not work when roads closely parallel streams, since there are few opportunities to filter the sediment-laden water through soils prior to it entering the stream. Other options such as surfacing roads with higher quality rock (and keeping it regularly graded), frequently clearing road ditches of accumulated ravel, or paving road surfaces can help in these situations. These options have not yet been pursued aggressively throughout the Forest because the costs are high. Mainline roads used during the wet season and located next to streams would be logical first candidates for such treatments. An alternative solution for problem roads located near streams is to decommission the road and instead use alternative ridge routes for log hauling. An example of road decommissioning on the Forest is the road along Big Creek (analysis basin #5) in the Tenmile region. Fills and culverts were removed where the road crossed streams and the road surface was outsloped and vegetated in order to create a stable road prism that needs no further maintenance.

Landslides Not Related to Roads

Another human-related source of fine and course sediment in streams is that derived from landslides within recent clearcuts. Field studies in the Oregon Coast Range indicate that the frequency of shallow landslides on very steep slopes is about 1.5 to 2.0 times greater in recent clearcuts than in mature stands (see Chapter 6, *Erosion and Sediment*). Nevertheless, this research also suggests that this initial increase in landslides is followed by a reduced landslide rate as plantations reach full canopy closure, followed then by an increase as the stands becomes mature. The negative aspects of an increase in fine sediments caused by a short-term increase in landslides from clearcut units are offset, to some extent, by the benefits to fish because landslides transport gravel and large wood into fish-bearing streams (see Chapter 6, *Erosion and Sediment* and Chapter 7, *Riparian Vegetation and Large Wood*). However, in many places streamside roads intercept the landslide material thereby preventing delivery of beneficial gravels and wood into stream channels.

The Oregon Department of Forestry occasionally faces legal and safety challenges concerning landslides and the public. Over 140 dwellings are located within a half-mile of the Forest boundary and many of these were constructed in landslide torrent paths. Furthermore, a major state highway skirts the steep, northern border and landslides originating on the Forest occasionally reach the highway. A number of measures have been used by Forest staff to minimize landslide problems. Much of the area above the state highway and a county road along Mill Creek has been taken out of the harvest land base and will never be logged. Elsewhere, slopes are not harvested where downhill houses are in the path of a future landslide.

Past timber harvest practices, whereby logs were removed from steep draws and trees growing near the draws were harvested, have left a reduced amount of large wood for landslides to move into fish-bearing streams. The analysis team was not able to quantify this reduction, although anecdotal information suggests that as stands approach 200 years old, steep draws fill with sizable amounts of large wood. On the Forest, draws within young plantations had very little wood. Over time, these practices have contributed to a reduction in the amount large wood in the Forest's streams.

It is common practice to remove landslide deposits that are intercepted by roads by piling the material to the side or removing it from the site. Much of this landslide material could benefit streams if it were instead placed in the stream downstream of the road. Current state and federal rules prohibit such activities, even if done during the time of year when there are no fish eggs in the stream. An evaluation of the current practices, in consultation with state and federal officials, may lead to a conclusion that a greater benefit would be obtained by placing the material in the stream.

Recommendation:

To increase the amount of course material in streams, the Forest should reexamine the current practice of piling or removing landslide deposits from the site and instead, look for opportunities to place logs, boulders, and gravel in the nearby stream as the road is being cleared.

Riparian Stands and Large Wood in Streams

Currently, wood volume in Forest streams averages much less than similar undisturbed streams located on nearby land. Forest streams average 28% of the wood volume of nearby undisturbed streams bordered by 90- to 120-year-old timber, and 14% of the wood volume of undisturbed streams bordered by old-growth timber (see Chapter 7, *Riparian Vegetation and Large Wood*). The interaction of historical and current management actions has contributed to the low amounts of large wood in the Forest's streams. In addition to the reduced delivery of wood by landslides, the intentional removal of wood in streams and harvest of streamside trees in the past also has contributed to a reduction of large wood within fish-bearing streams. Another factor contributing to the lack of persistent wood in streams is the inadvertent conversion of streamside areas from conifer or conifer/hardwood to stands dominated by hardwoods. Hardwood trees provide less volume of wood to streams over the long-term and the wood decays rapidly. Hardwoods are the dominant stand type currently found within 100 feet of fish-bearing streams on the Forest. Although hardwood dominance decreases with increasing distance from the stream, along large streams hardwoods still occupy over 30% of the land 150-200 feet from the stream. Streams draining the west side of the Forest in the Tenmile region have the highest percentage of streamside area dominated by hardwoods.

Recommendation:

The Forest should conduct a study of large wood in steep draws with stands of various ages and management histories. This would provide Forest managers with tools to understand current and future large wood within draws and how wood levels in fish-bearing streams are influenced by landslides delivering this wood to streams over time.

A model used by the analysis team to predict the amount of large wood in streams over time demonstrates the consequences of perpetuating hardwood stands along fish-bearing streams (see Chapter 7, *Riparian Vegetation and Large Wood*). The volume of wood in streams bordered by hardwood-dominated stands is predicted in 200 years to be only 10% of those streams bordered by conifer-dominated stands or 21% of those streams bordered by a mixed conifer/hardwood stand. The volume of large wood in streams bordered by hardwood-dominated stands is expected to decline by one-half over the next two centuries, while wood volume in streams bordered by other stand types is expected to increase considerably over current levels.

There are several options for increasing the amount of large wood in fish-bearing streams. One option examined in this analysis increased the buffer width on streams. The modeling showed that increasing the buffer width to 200 feet from the current standard of about 150 feet would result in only small increases in instream wood over the next three centuries.

Another option for accelerating the rate of wood accumulation in streams is to place logs in the stream when nearby timber harvest operations occur, or as a separate activity. Over the last decade, logs and boulders have been placed in fish-bearing streams at 31 locations on the Forest, most of which were in analysis basins #9, #11 and #12 in the West Fork Millicoma River Basin (see Chapter 8, *Aquatic Organisms and Their Habitat*). Nevertheless, with over 161 miles of fish-bearing stream on the Forest, and most of those miles currently low in large wood, it is a large and expensive task to supplement streams in this manner, and may not be feasible for many locations where access to the stream is difficult. Pulling over or yarding some streamside trees directly into the channel can reduce the cost of adding logs to streams. Preferably, candidate trees are those growing within 200 feet of the stream but have a low probability of ending up in the stream if they were to eventually tip over on their own. Implementing this approach requires coordination because of concerns with threatened and endangered species, particularly marbled murrelets.

Recommendation:

To address the near-term shortage of instream wood, the Forest should continue to add large wood to streams currently deficient. The Forest could focus on stream segments that have few conifers in the streamside forest to supplement future instream wood and where the costs of placing logs are low (near a road). Consider focusing first on streams with a bankfull width of less than 40 feet and increase effectiveness by using logs with attached rootwads or logs with lengths at least twice the bankfull width. Actions could concentrate on stream segments with year-round flow that are less confined by steep hillslopes or adjacent roads.

Conceivably, retaining more large wood in steep draws and trees growing around draws also would increase the volume of wood in fish-bearing streams, although the efficiency of this strategy compared to the direct placement of instream wood is unknown. The probability of a draw experiencing a landslide of sufficient size to transport wood into a fish-bearing stream is relatively low for any given decade. Nevertheless, the analysis team has provided a method to identify those draws most likely to deliver large wood and boulders to fish-bearing streams should a landslide occur, using information on channel gradient and the angle at which two channels converge (see Chapter 7, *Riparian Vegetation and Large Wood*).

Unfortunately, there are no quick fixes for addressing the limited wood in the Forest's streams. The streamside forest is the most important source of large wood. Input of wood, especially large conifer logs from riparian areas, will take decades (see Chapter 7, *Riparian Vegetation and Large Wood*). There is limited riparian habitat in the mature riparian conifer or mixed conifer/hardwood condition, which has implications for current and future large wood delivery and wildlife habitat. Riparian areas with mature conifer forests are important habitats for amphibians and many wildlife species (see Chapter 8*, Aquatic Organisms and Their Habitat* and Chapter 9, *Terrestrial Wildlife*).

In the longer term, the volume of wood in streams can be increased by several methods. One of the approaches is restricting the width of hardwood buffers (e.g., to less than 50 feet), harvesting hardwoods beyond the buffer, and establishing conifers in the harvested areas. Modeling results indicate only small near-term reductions in instream large wood with this strategy, followed by considerable gains in large wood over the next several centuries. There are some challenges to reestablishing conifers in streamside areas. First, the current practice of retaining buffers of trees and brush along streams has no counterpart in nature. Historically, large fires and landslides occurring every other century or so provided the bare ground near streams that would allow Douglas-firs to regenerate and get a head start over the brush and hardwood trees. Without this disturbance, regenerating conifers near streams will be difficult and may require new perspectives for managing streamside areas. Such techniques could include the intentional creation of small clearings along streams (not associated with timber harvest units) that now support brush and hardwoods, followed by aggressive conifer regeneration.

Recommendation:

To evaluate options for buffer widths and conifer regeneration in streamside areas now dominated by hardwood trees, the Forest should gather information on conifer regeneration success near streamside buffers, along with the likely success and cost of enhanced conifer regeneration techniques. A pilot project could be conducted on selected harvest units to demonstrate the use of alternative conifer regeneration techniques near streams and buffers.

Secondly, current herbicide spraying practices often result in a swath of land of up to 100 feet beyond the edge of the buffer that is not sprayed following clearcut harvest. While effective at keeping spray from damaging streamside buffers or entering streams, another consequence is patchy and sparse conifer regeneration near buffers due to rapid growth of competing brush. This is a critical area to have conifers growing since conifers beyond this distance have little chance of entering the stream once they fall over. Backpack spraying of brush near buffers, combined with mountain beaver trapping, seedling tubing, and the planting of tall seedlings can help improve conifer regeneration, although the added effort is costly.

It is those areas on the Forest that were harvested to the edge of streams followed by intensive site preparation and herbicide applications (typical of practices 20-35 years ago) that are best positioned for providing future wood to streams. In these areas, conifer tree density near streams is currently high.

Water Temperature

Naturally high levels of brush and trees along streams, followed by rapid regrowth of vegetation where human activities have exposed streams to sunlight in the past, have resulted in Forest streams that are relatively cool throughout their length, despite the naturally low streamflow levels throughout the summer (see Chapter 4, *Stream*

Recommendation:

In order to have a Forest-wide understanding of water temperature in streams, the Forest should monitor temperature in selected streams of the Umpqua region so that data are available for all three regions of the Forest.

Flow and Water Quantity and Chapter 5, *Water Quality*). Maximum water temperatures in various tributaries and the main channel of the West Fork Millicoma River were found to correlate well with distance from drainage divide and shade. In this area, streams warmed in a downstream direction and were warmest in stream segments where shade was less dense. Forest-wide shade measurements conducted during Oregon Department of Fish and Wildlife stream surveys indicate relatively high levels of shade over fish-bearing streams throughout the Forest, except for the widest streams. For wide streams, such as Mill Creek (analysis basin #1) and the lower West Fork Millicoma River (analysis basin #9), the tallest of streamside conifers are not capable of providing much shade to the channel.

Water temperature patterns for streams flowing into the Tenmile Lakes were different from streams in the Coos region. Streams in the Tenmile region tended to be cooler than those to the east, and there were no correlations with distance from drainage divide and shade. These streams may be cooler because they are closer to the ocean. Their natural coolness presents more opportunities to experiment with alternative techniques for establishing conifers in streamside areas that are currently dominated by hardwoods and brush. Here, the consequences of short-term decreases in stream shading and localized and small increases in stream temperature would be less stressful for fish. The Tenmile region also is the region most lacking conifers near streams (see Chapter 7, *Riparian Vegetation and Large Wood*).

Although poorly understood, the scarcity of gravel in streams Forest-wide, exacerbated by the low amounts of wood in the streams which functions to retain gravels in the channel, could be causing streams to be somewhat warmer than normal. As wood levels in streams increases and traps more gravel, there could be a cooling in streams as more of the stream flows subsurface through gravel deposits.

Recommendation:

To understand whether there could be water temperature reductions because of large wood trapping gravel and initiating subsurface flow paths, the Forest should monitor temperature at a few sites where logs are intentionally added to streams to improve fish habitat.

Fish Movement

A survival strategy for fish in the Coast Range is to migrate into cool and smaller tributaries during the hottest part of the summer to escape warmer water in larger streams (see Chapter 8, *Aquatic Organisms and Their Environment*). Upstream fish migrations take place at other times of the year also. Juvenile fish will often head back upstream following downstream displacement during high flows. During the spawning season, adult fish also move upstream. The natural ledges and waterfalls common to this steep sandstone terrain can make these migrations a challenge for fish. Fortunately, the current road system on the Forest does not create substantially more fish passage problems.

Recommendation:

To better understand the extent of culvert-related obstacles, the Forest should increase efforts to identify all streams used by fish. Consider focusing first on those unexamined streams falling into the medium size class.

Culverts in fish-bearing streams average only 1 per 4.5 square miles of the Forest. Forest-wide, only 14 of these culverts have characteristics that could impede upstream fish movement (a high drop at the outlet or steep pipe gradient). Nearly all are located in the Coos region. During the last few years, Forest staff have removed or replaced 15 problem culverts. Removal or replacement of the final 14 culverts that impede passage would allow fish to migrate freely into an additional 6 miles of stream. These remaining culverts are located in smaller and steeper streams. It is often expensive, and sometimes impossible, to provide fish passage through culverts in steep streams.

Recommendation:

To complete the elimination of culvert-related fish obstacles, the Forest should continue to remove, replace, or modify the few remaining culverts blocking fish migration. Consider focusing first on sites where the culvert blocks the greatest length of potential fish habitat. *(*See Chapter 8*, Aquatic Organisms and Their Habitat).*

Other human activities in the basin have contributed to the expansion of fish migration throughout the Forest. Blasting of pools and a channel (in 1958) around the previously impassable Stulls Falls, located on the lower West Fork Millicoma River, currently allows fish access into this highly productive basin (see Chapter 3, *Historical Overview*). Also, a fish ladder constructed near the mouth of Elk Creek allows migratory fish to access this large tributary of the West Fork Millicoma River.

Water Characteristics

In addition to water temperature, the water characteristics of Forest streams are generally favorable for fish (see Chapter 5, *Water Quality*). Dissolved oxygen levels are high and any leaching of nitrogen into streams during the critical summer months from newly-clearcut areas is quickly absorbed by downstream aquatic plants. Phosphorous in the water column during summer is nearly non-existent, pointing towards an algae community that is held in check by the availability of additional phosphorus and not nitrogen. Similarly, nuisance algae growth in Tenmile Lakes is controlled largely by the availability of phosphorus. Some of this phosphorus comes from sediment deposited by streams into the lakes during the wet season and some likely comes from lakeside septic systems. Also, the lakes now have large populations of introduced fish that consume zooplankton. These small organisms, in turn, are major consumers of algae and their depressed numbers may be adding to the algae problem in the lakes.

Recommendation:

For the upcoming TMDL process for Tenmile Lakes, the Forest should update the 1997-1998 road inventory in basins draining into the lakes, in order to detect any new, discrete sources of accelerated sedimentation.

There is no indication that streams flowing from the Forest into the lakes currently carry sediment loads that are any greater than natural rates. Timber harvesting on Forest land in these basins has nearly stopped in recent years since they have been designated long-rotation basins. Sediment cores taken from the lake bottom suggest that accelerated erosion

Recommendation:

In anticipation of possible restrictions on the use of 2,4-D and triclopyr, the Forest should modify brush control plans to include substitute herbicides as ordered under the review of pesticides by USEPA.

from these and surrounding lands probably occurred in the past, a time when roads were constructed and some slopes logged using practices that are not acceptable today.

Many of the 140 residences located immediately downstream from the Forest boundary obtain water from streams flowing from the Forest (see Chapter 4, *Stream Flow and Water Quantity*). Sediment from roads and from landslides in timber harvest units has the potential of increasing stream turbidity and requiring greater treatment of water before use. Also, herbicide concentrations in streams may be of potential concern, although monitoring in other parts of the Pacific Northwest shows that the amount of herbicides in streams from aerial application techniques adopted by the Forest is extremely small.

Recommendation:

To better understand whether herbicide application methods are effective, the Forest should monitor herbicide concentrations in streams during and after some spray operations.

It is highly likely that some users of water from Forest streams have not obtained a water certificate from the Water Resources Department or arranged a deed of water conveyance where the water diversion point is not located on their land. This may make it difficult for Forest staff to plan timber sales near the Forest boundary and work with these landowners to keep water systems from being crushed during timber falling and yarding.

Recommendation:

To make timber harvest planning more efficient and ensure compliance with state water laws, the Forest should continue using field investigations to determine the presence of legal and illegal water diversions within proposed harvest units. There does not seem to be a need for a detailed Forest-wide evaluation of water diversions along the Forest fringe. Users that divert water from Forest streams could be encouraged to obtain a water use permit and deed of conveyance. Also consider encouraging users to move points of diversion outside the Forest boundary.

Also, the Forest should consider obtaining in water use permits/certificates from the Water Resources Department for the 98 pump chances that currently do not have a permit/certificate.

While summer stream flows are naturally low for the sandstone terrain of the Forest, timber harvest does not often dry up streams (see Chapter 4, *Stream Flow and Water Quantity*). Research on Pacific Northwest streams indicates that clearcut harvesting increases summer flows, which can have benefits to fish and aquatic amphibians. The extra flow can provide more living space for aquatic animals and the greater water depth helps moderate temperature increases.

Research on Pacific Northwest streams indicates that increases in peak flows due to clearcut harvest and road building are minor for lower-elevation terrain and where harvest units do not experience hot broadcast burns. Increases in peak flow, where they do occur, are limited to minor runoff events; the magnitude of large floods is not affected. Any measurable increases in peak flow due to clearcut harvest and road building occur only in very small watersheds. In larger streams, the contributions from smaller subwatersheds, some of which may have increased peak flows and some with intact timber, results in a muted response since the timing of the maximum flow for the various subwatersheds is rarely synchronized for any given storm. Furthermore, any increase in peak flow due to clearcut harvesting is short-lived (less than 15 years) due to regrowth of brush and trees.

Timber Harvest

The annual timber harvest on the Forest includes about 515 acres of clearcuts and 535 acres of thinning. The age distribution of timber on the Forest is highly skewed towards plantations less than 25 years old (29%) and stands older than 100 years (48%; see Chapter 2, *Watershed Analysis Area Overview*). Clearcut harvest occurs mostly in timber that is older than 100 years, which also are the stands most preferred by the marbled murrelet and northern spotted owl. Strategies to provide long-term habitat for these two species has lead to a partitioning of the Forest into short-rotation basins (80 years) and long-rotation basins (160-240 years). Over 50% of the Forest has been designated as long-rotation basins. This includes most of the watersheds draining north into the Umpqua River (Umpqua region) and west into Tenmile Lakes (Tenmile region). Consequently, most clearcut timber harvest now occurs in the Coos region. Habitat Conservation Areas cover about 7% of the Forest and are scattered about in both short-rotation and long-rotation basins. The purpose of these areas is to provide for a permanent reserve of intact, older timber that provides connectivity to unique habitat for amphibians, fish, marbled murrelets, and northern spotted owls (see Chapter 9, *Terrestrial Wildlife*).

The Forest is developing an updated *Management Plan*, which will include the aquatic strategies described in the *Northwest Oregon State Forests Management Plan*. To test the operational feasibility of these strategies, fiscal year 2004 timber sales will incorporate these strategies. A major change over current practices is the maintenance of a buffer of trees along seasonal streams.

CONCLUSION

Most current management strategies on the Forest effectively address the aquatic, water quality, hydrologic, and public safety concerns inherent to this challenging terrain. The factors that currently depress aquatic productivity are mostly natural in origin or are related to management practices from past decades. Forest staff has successively initiated a number of measures to compensate for past practices, including the placement of logs in fish-bearing streams, replacing culverts that do not pass fish, and repairing roads before weak sections fail. Other topics, such as reducing fine sediments that originate from roads and providing for long-term sources of large conifer wood in steep draws and in hardwood-dominated streamside areas, have received lesser attention. The scarcity of tested methods for improving conditions, limited monitoring information for some of the problems, and the high expense of solutions has slowed progress on these topics.

The Forest's current landscape-level strategies directed at supporting fish and wildlife species that are sensitive to timber harvest are more rigorous than required by the Forest Practices Act. Areas off limits to future timber harvest or assigned to the growing and harvest of old trees make up a significant portion of the Forest. Since they include both slopes and valley bottoms, these special management areas provide habitat for both wildlife and fish.

Interactions with state and federal agencies, along with the general public, will be common in the near future as the Forest staff updates the *Management Plan* and develops a new *Habitat Conservation Plan* for marbled murrelets, spotted owls, and coho salmon. In addition, Forest staff will need to be involved in upcoming Total Daily Maximum Load processes for the West Fork Millicoma River watershed (water temperature issues) and the watersheds that flow into Tenmile Lakes (sediment issues). Because of the Forest's isolation from high population centers, scrutiny of management practices on the Elliott State Forest have been less than for other State Forests in northwest Oregon. Future public review processes highlight the need for continued documentation and review of management practices. Information on topics, such as herbicide concentrations in streams following aerial application of herbicides and water temperature of streams flowing into the Umpqua River, can be important when engaged in public processes and reviewing current practices.

The information currently available for the Forest points to activities that would fill important information gaps and address current habitat deficiencies. The highest priority recommendations from the analysis team include:

1. To resolve the current lack of large wood in streams, the Forest should increase large wood volume by direct placement of logs in fish-bearing streams and the reestablishment of conifer trees in streamside areas that once grew conifers but now support mostly hardwoods. In-channel wood placement could concentrate on two management opportunity areas: Operational and strategic. Operational restoration actions would focus opportunistically on stream reaches within or nearby timber sales; strategic actions would target specific low gradient stream reaches that have the potential for high quality habitat but limited in-channel wood.

2. To prepare for the upcoming Total Maximum Daily Load study of sediment and nutrients in Tenmile Lakes by the Department of Environmental Quality, the Forest should conduct an inventory of remaining discrete sources of sediment along roads within the watersheds that drain into the lakes.

3. To confirm that application methods are effective at keeping herbicides out of streams, the Forest should monitor herbicide concentrations for several spray operations.

4. To reduce the amount of fine sediments entering stream channels from roads, the Forest should examine cost-effective means for diverting ditch water onto stable locations and continue to disconnect ditches from stream channels. The highest priority should be considered for roads that are heavily used during the wet season.